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Clinical outcomes of endoscopic submucosal dissection for colorectal tumors: a large multicenter retrospective study from the Hiroshima GI Endoscopy Research Group CME

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Background and Aims: Although advanced high-volume centers have reported good outcomes of colorectal endoscopic submucosal dissection (ESD), a limited number of highly skilled experts in specialized institutions performed these procedures. We undertook a retrospective multicenter survey, which included nonspecialized hospitals, to investigate the clinical outcomes of colorectal ESD.

Methods: We recruited 1233 consecutive patients with 1259 colorectal tumors resected by ESD at 12 institutions. We evaluated the en bloc resection rate, histologic complete resection rate, curative (R0) resection rate, adverse events, and the long-term prognoses, including local recurrence, metachronous tumor development, and survival rate.

Results: The en bloc, histologic complete, and R0 resection rates were 92.6%, 87.4%, and 83.7%, respectively. The delayed bleeding, intraoperative perforation, and delayed perforation rates were 3.7%, 3.4%, and .4%, respectively. The long-term outcomes analysis included 1091 patients (88.4%). Local recurrences occurred in 1.7%, and metachronous tumors (>5 mm) developed in 11.0% of the patients. The 3- and 5-year overall survival rates were 95.1% and 92.3%, respectively. The number of colonic tumors, severe submucosal fibrosis, and en bloc resection rates were significantly higher in the high-volume centers (Group H) than those in the low-volume centers (Group L). The average tumor size in Group H was significantly larger than that in Group L.

Conclusions: Colorectal ESDs are feasible, have acceptable adverse event risks, and favorable long-term prognoses. (Clinical trial registration number: UMIN000016197.) (Gastrointest Endosc 2018;87:714-22.)

Abbreviations: ESD, endoscopic submucosal dissection; JSCCR, the Japanese Society for Cancer of the Colon and Rectum; LST-G, laterally spreading tumors of the granular type; LST-NG, laterally spreading tumors of the non-granular type; SD, standard deviation.

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In Japan, colorectal endoscopic submucosal dissection (ESD) received health insurance approval in April 2012, and it is a reliable method for treating superficial colorectal tumors. Indeed, it is now possible to resect large tumors completely and to evaluate tumors pathologically in detail using ESD.[1-18] Because the morbidity associated with colon carcinomas is rising in Japan,[19] the number of ESDs for colorectal tumors will continue to increase.

Colorectal ESD is technically more difficult and requires more experience than gastric ESD because of difficulties associated with endoscope control and the anatomic features of the colorectal region, including the presence of folds, bending of the intestinal tract, and the thinness of the intestinal wall. Although advanced high-volume centers have reported good outcomes from colorectal ESD,[8,11,13,20-24] the procedures were performed by a limited number of highly skilled experts. Few reports are available that describe the outcomes from colorectal ESD performed by less-experienced endoscopists at institutions that have recently introduced colorectal ESD, and the current status regarding colorectal ESD at a regional level has not been disclosed. The aim of this study was to undertake a retrospective multicenter survey, which included nonspecialized hospitals in the Hiroshima area, to investigate the clinical outcomes of colorectal ESD.

METHODS

Patients

This retrospective analysis was conducted at 12 hospitals, comprising 1 academic center and 11 community hospitals (Hiroshima GI Endoscopy Research Group), in the Hiroshima area that had different levels of experience in colorectal ESD. Between January 2008 and March 2014 we recruited 1233 consecutive patients, comprising 748 men and 485 women with a mean age of 69 years (standard deviation [SD], 23), who had 1259 colorectal tumors that were resected using ESD. Table 1 summarizes the clinical characteristics of the patients and the tumors that were treated by ESD at each institution. All data were processed centrally.

The indications for ESD were defined using the criteria proposed by the Japan Gastroenterological Endoscopy Society[25] and the Japanese Society of Gastroenterology.[26] ESD was indicated for tumors that required en bloc resection and for which en bloc resection using snare EMR would have been difficult,[27] which included laterally spreading tumors of the nongranular type (LST-NG), particularly, the pseudodepressed type; tumors with a type V_I pit pattern; carcinomas with submucosal shallow invasions <1000 μm; large depressed tumors; and large elevated tumors that were probably malignant, including large nodular lesions such as laterally spreading tumors of the granular type (LST-G). In addition, ESD was indicated for intramucosal tumors with fibrosis caused by biopsy sampling or peristalsis, local residual early-stage carcinomas that developed after endoscopic resection, and sporadic localized tumors associated with chronic intestinal inflammation conditions, including ulcerative colitis.

The study was performed in accordance with the Declaration of Helsinki. All patients were informed of the risks and benefits of ESD, and each patient provided written informed consent for the procedure to be performed. None of the patients refused ESD for colorectal tumors during the study period. The clinical trial number for this study is UMIN000016197 (Institutional Review Board registration date: January 14, 2015).

ESD procedure

The ESD procedures were performed using ESD devices and involved the use of a dual knife (Olympus Medical Systems Corp, Tokyo, Japan), flex knife (Olympus Medical Systems Corp), hook knife (Olympus Medical Systems Corp), IT knife (Olympus Medical Systems Corp), flush knife (Fujifilm Corporation, Tokyo, Japan), and an SB knife Jr (Sumitomo Bakelite Co, Ltd, Tokyo, Japan), as appropriate, for each tumor. After the injection of a 10% glycerin solution and/or .4% sodium hyaluronate (Muco Up; Johnson & Johnson, New Brunswick, NJ) into the submucosal layer, a circumferential incision was made using a single ESD knife, and the ESD was performed using 1 or 2 ESD knives.

Histologic assessment

All specimens were fixed in 10% formalin, cut into 2-mm sections, and examined microscopically. A histologic complete resection was defined as a histopathologically complete en bloc resection with negative tumor margins. A curative (R0) resection was determined using the Japanese Society for Cancer of the Colon and Rectum (JSCCR) guideline criteria, which involved satisfying all 4 of the following characteristics: a well/moderately differentiated or papillary carcinoma, no vascular invasion, a submucosal invasion depth <1000 μm, and grade 1 budding.[19]

The inclusion of an additional colectomy with lymph node dissection was considered based on the guidelines that were current at the time.[28,29] In this study we retrospectively reassessed all tumors using the 2016 JSCCR guidelines.

Variable evaluation

We evaluated the clinicopathologic characteristics of the patients and tumors, procedure times, en bloc resection rate, histologic complete resection rate, R0 resection rate, adverse events, and long-term prognoses, including local recurrences, metachronous tumor development, and the survival rate. Poor scope operability was defined as situations in which paradoxical movement of the endoscope, poor control with adhesions, and lesion motion with heart beats or breathing occurred, as reported previously.[30] Endoscopically, the degree of submucosal fibrosis was classified as no fibrosis, mild fibrosis, and severe fibrosis. Delayed bleeding was defined as a reduction in the hemoglobin level ≥2 g/dL compared with the preoperative level, apparent bleeding, or massive

TABLE 1. Clinical characteristics of patients and tumors treated by endoscopic submucosal dissection at each institution

Variable	Institution											
	1	2	3	4	5	6	7	8	9	10	11	12
Number of patients	548	164	164	126	80	65	44	23	5	5	5	4
Number of tumors	562	169	167	126	84	65	44	23	5	5	5	4
Operator's experience in colonoscopy, y, mean (SD)	29 (2)	19 (2)	16 (4)	14 (2)	21 (4)	17 (6)	11 (3)	11 (2)	20 (1)	16 (1)	12 (2)	12 (.5)
Sex, male/female	332/216	104/60	98/66	72/54	48/32	38/27	28/16	15/8	4/1	2/3	4/1	3/1
Age, y, mean (SD)	67 (11)	68 (10)	69 (10)	69 (12)	68 (9)	70 (10)	71 (9)	67 (9)	74 (5)	69 (17)	66 (9)	59 (12)
Tumor location												
Right side of colon, n	236	56	93	37	26	26	13	5	0	1	1	1
Left side of colon, n	118	40	20	37	18	8	12	6	3	0	0	2
Rectum, n	208	73	54	52	40	31	19	12	2	4	4	1
Growth type												
LST-G, n	271	83	77	57	27	52	19	14	1	3	2	1
LST-NG, n	214	34	70	45	31	9	20	8	4	1	1	3
Polypoid, n	77	52	20	24	26	4	5	1	0	1	2	0
Tumor size, mm, mean (SD)	36 (19)	34 (17)	30 (14)	26 (18)	29 (13)	29 (11)	23 (11)	36 (19)	19 (5)	26 (6)	22 (7)	25 (5)
Experience of taking part in the previous multicenter study	Yes	No	No	No	No	No	No	No	No	No	No	No

SD, Standard deviation; *LST-G*, laterally spreading tumor of the granular type; *LST-NG*, laterally spreading tumor of the nongranular type.

melena.[31] We categorized the 12 participating hospitals into high-volume centers (Group H) or low-volume centers (Group L), based on the number of ESDs performed during the study period (100 tumors/6 years) in accordance with a previous report.[11] We compared the groups with respect to the clinicopathologic characteristics of the tumors and the clinical outcomes of ESD.

Surveillance after ESD

At 1 year after ESD, follow-up colonoscopies were performed on patients who had undergone histologically complete resections of high-grade dysplasias and T1 carcinomas that had met the curative criteria. For the patients whose resections of their high-grade dysplasias were piecemeal and whose tumors had histologically positive horizontal margins, follow-up colonoscopies were performed at 3 to 6 months after ESD, and further colonoscopies were performed 1 year later. For the patients who had undergone ESD for T1 carcinomas that had not met the curative criteria, blood tests, including the carcinoembryonic antigen level, and CT of the abdomen and pelvis were performed every 6 months postoperatively for the first 3 years and every 12 months thereafter, and follow-up colonoscopies were performed every year. We sent a questionnaire to those patients who did not have any follow-up medical records at our institution or at our partner centers to investigate the long-term outcomes.

Statistical analyses

The Student *t* test and the Mann-Whitney U test were used to compare the continuous variables, and the Pearson χ^2 test and the Fisher exact probability test were used to compare the categorical variables. The Kaplan-Meier method was used for the survival analyses and to determine the proportion of the patients with metachronous tumors. $P < .05$ were considered statistically significant. All statistical analyses were performed using JMP software, version 10 (SAS Institute Inc., Cary, NC).

RESULTS

Clinicopathologic characteristics of the cases

Table 2 shows the clinicopathologic characteristics of tumors and patients. Regarding the locations of the tumors, 495 tumors (39.3%) were located in the right side of the colon, 264 tumors (21.0%) were located in the left side of the colon, and 500 tumors (39.7%) were located in the rectum. There were 607 LST-G (48.2%), 440 LST-NG (35.0%), and 212 polypoid tumors (16.8%). Histologically, 667 tumors (53.0%) were high-grade dysplasias, 104 tumors (8.3%) were superficial submucosal invasive carcinomas (<1000 μm), 153 tumors (12.1%) were deep submucosal invasive carcinomas (≥1000 μm), and 335 tumors (26.6%) were low-grade dysplasias.

Short-term outcomes

The short-term outcomes of colorectal ESD are shown in Table 3. The mean (SD) tumor size was 33 (17) mm (range, 10-138), and the mean (SD) procedure time was 92 (66) minutes (range, 5-660). The en bloc resection, histologic complete resection, and R0 resection rates were 92.6%

TABLE 2. Clinicopathologic characteristics of patients and tumors treated by endoscopic submucosal dissection at the high- and low-volume centers

Variable	Total	Group		*P* value
		High-volume centers	Low-volume centers	
Number of patients	1233	1002	231	
Number of tumors	1259	1024	235	
Sex				
Male	748 (60.7)	606 (60.5)	142 (61.5)	NS
Female	485 (39.3)	396 (39.5)	89 (38.5)	
Age, y, mean (SD)	69 (23)	69 (25)	69 (10)	NS
Tumor location				
Right side of colon	495 (39.3)	422 (41.2)	73 (31.0)	<.05
Left side of colon	264 (21.0)	215 (21.0)	49 (20.9)	
Rectum	500 (39.7)	387 (37.8)	113 (48.1)	
Growth type				
LST-G	607 (48.2)	488 (47.7)	119 (50.6)	NS
LST-NG	440 (35.0)	363 (35.4)	77 (32.8)	
Polypoid	212 (16.8)	173 (16.9)	39 (16.6)	
Use of anticoagulants and/or antiplatelet therapy				
Yes	147 (11.7)	110 (10.7)	37 (15.7)	NS
No	1112 (88.3)	914 (89.3)	198 (84.3)	
Submucosal fibrosis				
None or mild	941 (74.7)	747 (72.9)	194 (82.6)	<.05
Severe	318 (25.3)	277 (27.1)	41 (17.4)	
Histology				
Low-grade dysplasia	335 (26.6)	260 (25.4)	75 (31.9)	<.05
High-grade dysplasia	667 (53.0)	542 (52.9)	125 (53.2)	
T1 carcinoma (<1000 μm)	104 (8.3)	88 (8.6)	16 (6.8)	
T1 carcinoma (≥1000 μm)	153 (12.1)	134 (13.1)	19 (8.1)	

Values are number of cases with percents in parentheses, unless otherwise noted.
NS, Not significant; *SD*, standard deviation; *LST-G*, laterally spreading tumor of the granular type; *LST-NG*, laterally spreading tumor of the non-granular type.

(1166/1259), 87.4% (1100/1259), and 83.7% (1054/1259), respectively. Regarding the non-R0 resected tumors, 134 tumors (10.6%) underwent additional surgical resection and 71 tumors (5.6%) were followed without surgery because either the patients refused to undergo additional surgical resection and/or they had severe concomitant diseases. Delayed bleeding after ESD occurred in 46 patients (3.7%). Intraoperative perforations occurred in 43 patients (3.4%), and 6 of these patients (.5%) required surgery. Delayed perforations occurred in 5 patients (.4%), and 4 of these patients (.3%) required surgery.

Long-term outcomes

To evaluate the long-term outcomes we excluded 11 patients with 11 tumors whose ESD procedures could not continue because of perforations (5 patients, 5 tumors), submucosal severe fibrosis (4 patients, 4 tumors), and intraoperative bleeding (2 patients, 2 tumors). We excluded an additional 131 patients who were lost to follow-up within 6 months. Hence, 1091 patients with 1117 tumors (88.7%) were included in the analysis of the long-term outcomes, and the mean (SD) follow-up duration was 36 (21) months (range, 6-90) (Fig. 1).

Figure 2 presents the survival curves. The 3- and 5-year overall survival rates were 95.1% and 92.3%, respectively. Both the 3- and 5-year disease-specific survival rates were 99.6%. Of 1091 patients, 45 patients (4.1%) died because of concomitant diseases and 2 patients (.2%) died because of their colorectal carcinomas. Table 4 summarizes the characteristics of the patients who died because of their colorectal carcinomas.

To evaluate metachronous tumor development, we excluded 209 patients who did not undergo colonoscopy after ESD, and we assessed 882 patients with 904 tumors (Fig. 1). The cumulative incidence rate for metachronous tumor development is shown in Figure 3. The mean (SD) follow-up duration was 30 (19) months (range, 6-90). Metachronous tumors (>5 mm) developed in 11.0% of patients

TABLE 3. Outcomes of endoscopic submucosal dissection for colorectal tumors at the high- and low-volume centers

Variable	Total	Group		*P* value
		High-volume centers	Low-volume centers	
Tumor size, mm, mean (SD)	33 (17)	40 (18)	28 (13)	<.01
Scope operability				
Good	873 (69.3)	712 (69.5)	161 (68.5)	NS
Poor	386 (30.7)	312 (30.5)	74 (31.5)	
Procedure time, min, mean (SD)	92 (66)	92 (65)	96 (67)	NS
Resection status				
En bloc	1166 (92.6)	959 (93.7)	207 (88.1)	<.05
Piecemeal	82 (6.5)	58 (5.7)	24 (10.2)	
Discontinued procedure	11 (0.9)	7 (0.6)	4 (1.7)	
Histologic complete resection				
Complete	1100 (87.4)	898 (87.7)	202 (86.0)	NS
Incomplete	159 (12.6)	126 (12.3)	33 (14.0)	
Endoscopic curability				
R0 resection	1054 (83.7)	844 (82.4)	210 (89.4)	<.05
Non-R0 resection	205 (16.3)	180 (17.6)	25 (10.6)	
Follow-up	71 (5.6)	66 (6.5)	9 (3.8)	
Additional surgical resection	134 (10.6)	114 (11.1)	16 (6.8)	
Adverse events				
Delayed bleeding	46 (3.7)	38 (3.7)	8 (3.4)	NS
Intraoperative perforation	43 (3.4)	36 (3.5)	7 (3.0)	
Required surgery	6 (.5)	5 (0.5)	1 (0.4)	
Delayed perforation	5 (.4)	5 (0.5)	0 (0)	
Required surgery	4 (.3)	4 (0.4)	0 (0)	

Values are number of cases with percents in parentheses, unless otherwise noted.
SD, Standard deviation; *NS*, not significant.

(97/882), and high-grade dysplasias and T1 carcinomas developed in 1.1% of patients (10/882).

To evaluate local tumor recurrence, we excluded 94 tumors that underwent additional surgery, and we investigated 810 tumors. Local recurrences were observed in 1.7% of the tumors (14/810). The characteristics of these tumors are shown in Table 5.

Histologically, 5 primary tumors were low-grade dysplasias, 8 were high-grade dysplasias, and 1 was a T1 carcinoma. Five of these tumors were resected using the piecemeal method, and the local recurrence rate was significantly higher after piecemeal resections compared with that for en bloc resections ($P < .01$). The times to recurrence ranged from 6 to 53 months. Thirteen tumors underwent additional endoscopic resections, and 1 tumor required surgery.

Comparisons of Groups H and L with respect to the clinicopathologic characteristics of tumors and procedural outcomes

Table 2 summarizes the clinicopathologic characteristics of patients and tumors treated at the hospitals in Groups H and L. The hospitals in Group H treated 1002 patients with 1024 tumors and those in Group L treated 231 patients with 235 tumors. The proportion of rectal tumors in Group L (48.1%) was significantly higher than that in Group H (37.8%; $P < .05$). The severe submucosal fibrosis rate was significantly higher in Group H (27.1%) compared with that in Group L (17.4%; $P < .05$). The proportion of histologically verified T1 carcinomas (≥1000 μm) in Group H (13.1%) was significantly higher than that in Group L (8.1%; $P < .05$). There were no significant differences between the groups in relation to the sex ratio, the average age of the patients, the tumor growth types, and the ratios of the use of anticoagulants and/or antiplatelet therapy.

Table 3 summarizes the procedural outcomes associated with ESD in Groups H and L. The mean (SD) tumor size in Group H was 40 (18) mm (range, 10-138) and that in Group L was 28 (13) (range, 10-85), a difference that was significant ($P < .01$). The mean (SD) procedure times were 92 (65) minutes in Group H and 96 (67) minutes in Group L, a difference that was not significant. The en bloc resection rate was significantly higher in Group H (93.7%) compared with that in Group L (88.1%; $P < .05$). The

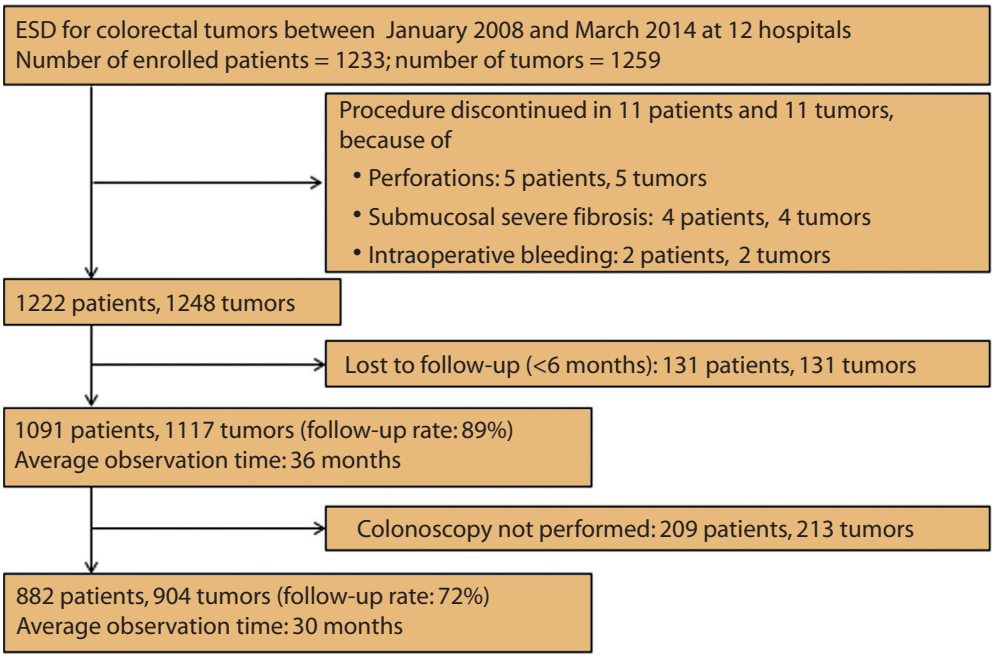

Figure 1. Flowchart of the enrolled patients and the tumors. *ESD*, Endoscopic submucosal dissection.

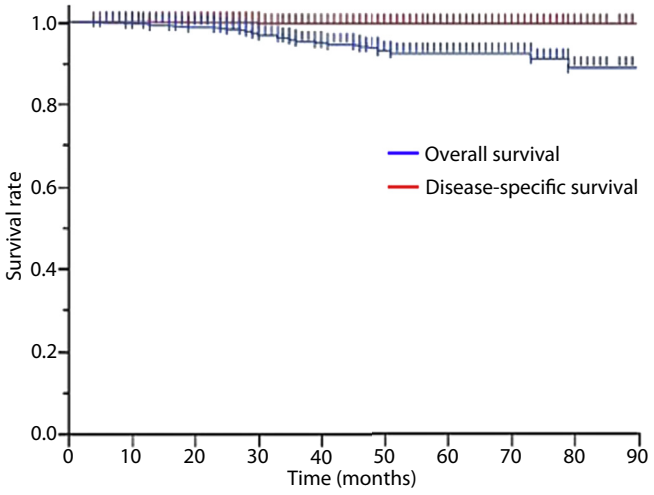

Figure 2. Survival curve after endoscopic submucosal dissection for colorectal tumors.

histologic complete resection rates were 87.7% in Group H and 86.0% in Group L, a difference that was not significant.

Delayed bleeding occurred in 38 patients (3.7%) in Group H and in 8 patients (3.4%) in Group L. Intraoperative perforations occurred in 36 patients (3.5%) in Group H and in 7 patients (3.0%) in Group L. There were no significant differences between the groups in relation to the adverse events.

DISCUSSION

Although several large case series studies have assessed the outcomes from colorectal ESD, most of the analyses were undertaken in high-volume centers until now. Nakajima et al[22] conducted a prospective multicenter study at medium- and high-volume specialized facilities and reported that the endoscopic en bloc resection rate was 94.5%, the perforation rate was 1.6%, and the delayed bleeding rate was 2.2%. Lee et al[21] reported an overall endoscopic en bloc resection rate of 97.5%, an R0 resection rate of 91.2%, and a perforation rate of 5.3%. Repici et al[32] undertook a systematic review of 22 studies and reported a histologically verified per-lesion resection rate of 88% and a per-lesion rate of 1% for surgical intervention after adverse events associated with ESD.

Our data demonstrate the safety and efficacy of colorectal ESD procedures carried out in the Hiroshima region. The findings from the present study demonstrated almost equivalent colorectal ESD statistics compared with those reported previously, despite including low-volume centers. As we reported previously,[17] en bloc resection using ESD as a total excisional biopsy sampling method for a clinical T1 colorectal carcinoma is an appropriate and effective treatment, and we attempted ESD for clinical T1 carcinomas in some cases. As a result, 13.1% of the tumors in Group H were deep submucosal invasive carcinomas (≥1000 μm), which may explain why our R0 ESD resection rate was lower than that reported previously.

The en bloc resection rate in Group L was significantly lower than that in Group H. Reports from studies that investigated colorectal ESD learning curves have been published.[33,34] Yang et al[34] evaluated the feasibility of surgeons without experience in gastric ESD performing colorectal ESD. They reported that ESD was attempted on 250 colorectal tumors by an endoscopist and that significant

TABLE 4. Characteristics of the patients who died of recurrent colorectal carcinoma after endoscopic submucosal dissection

Variable		Case 1	Case 2
Age, y		46	75
Sex		Female	Female
Characteristics of the lesion			
	Location	Sigmoid colon	Rb
	Type	Is+IIa	Is+IIa
	Histologic type	wel>mod	mod
	Depth of submucosal invasion, μm	1900	3500
	Budding	Grade 3	Grade 3
	Vessel involvement	ly0, v0	ly1, v1
	Horizontal margin	0	0
	Vertical margin	0	0
Additional surgical resection		No	No
Time to recurrence from ESD, mo		41	13
Recurrence pattern		Multiple liver metastases	Multiple lung metastases
		Lymph node metastasis	Lymph node metastasis
Time to death from ESD, mo		71	19

Rb, Rectum below the peritoneal reflection; *wel*, well-differentiated adenocarcinoma; *mod*, moderately differentiated adenocarcinoma; *ly*, lymphatic invasion, *v*, venous invasion; *ESD*, endoscopic submucosal dissection.

improvements were observed in the success rate (from 72% to 94%; $P = .001$) and the perforation rate (from 14% to 0%; $P = .003$) as the surgeons gained experience. Sato et al[35] reported that severe fibrosis contributed to incomplete resections and difficult colorectal ESD procedures and that a larger tumor size was one of the independent factors that contributed to the difficulty of the colorectal ESD procedure. Furthermore, we reported that poor endoscope operability and severe fibrosis were significant independent predictors of perforation.[30] Imai et al[36] reported that among less-experienced endoscopists, colonic tumors were independent predictors of en bloc resection failure and perforation. The data from the current study showed that compared with Group L, the numbers of tumors with severe submucosal fibrosis and colonic tumors were higher in Group H. In addition, the average size of the tumors was larger in Group H compared with that in Group L. The tumors were allocated according to the level of technical expertise within each facility. On the other hand, Takeuchi et al[37] reported that less-experienced endoscopists should perform colorectal ESD on LST-G initially, because of the poor lifting that frequently occurs after the submucosal injection during ESD for LST-NG and protruding tumors. Furthermore, poor lifting after the submucosal injection during colorectal ESD was the risk factor that was most frequently associated with technical difficulties and adverse events.[37] There were no significant

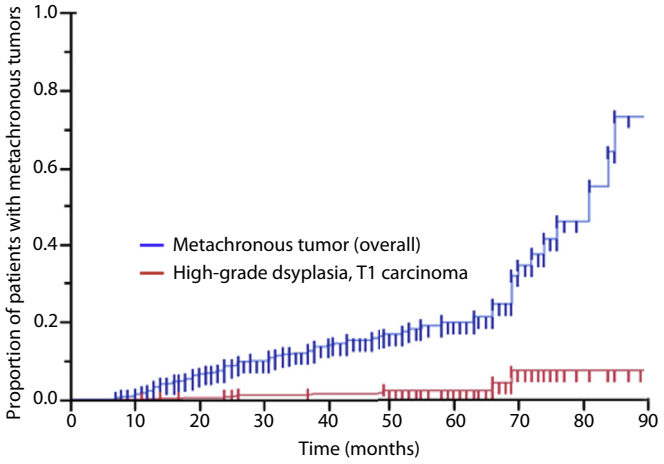

Figure 3. Metachronous tumor development after endoscopic submucosal dissection for colorectal tumors.

differences between Group H and Group L with respect to the tumor growth types. Colorectal tumors should be allocated more appropriately within the region by considering the tumor growth types and endoscope operability.

Some previously published articles describe the long-term outcomes from ESD for colorectal tumors.[20,38-40] We conducted a single-center retrospective study with a median follow-up duration of 79 months and reported that the 5-year overall survival and disease-specific survival rates after colorectal ESD were 94.6% and 100%, respectively.[24] The data from the present study were almost equivalent to those reported previously in relation to long-term outcomes, despite including low-volume centers. Only 2 patients (.2%), who rejected additional surgical resections, died as a consequence of their colorectal carcinomas, and the prognosis for colorectal ESD was good. The findings from another multicenter prospective cohort study, which was a JSCCR research project, showed that the local recurrence rate for colorectal neoplasias ≥20 mm after ESD was 1.4% and that a significant factor associated with local recurrence was a piecemeal resection during ESD.[23] However, our study showed that local recurrences occurred in 6 of 810 tumors, even though en bloc resections and R0 resections had been achieved. It is important to detect the minute amounts of residual tumor tissue that surround the resected ulcer or ulcer bed after ESD, even when an en bloc resection has been achieved, and to evaluate and confirm the pathologic horizontal margin carefully. Moreover, given that metachronous tumors developed in 11.0% of the patients in our study, regional surveillance is important to detect local recurrences and metachronous tumors more rapidly after ESD.

This study has some limitations. First, this was a retrospective study based on clinical records. Second, we could not follow all patients who underwent ESD; 11% of patients were lost to follow-up within 6 months and 28% of patients

TABLE 5. Characteristics of the cases who experienced local recurrence after endoscopic submucosal dissection for colorectal tumors

			Characteristics of initial lesions							Characteristics of local recurrent lesions				
Case no.	Age (y)	Sex	Location	Size (mm)	Growth type	Histologic diagnosis	Resection status	HM	VM	Time to recurrence (mo)	Size (mm)	Growth type	Histologic diagnosis	Treatment method
1	71	F	Rb	35	LST-G	Low-grade dysplasia	Piecemeal	+	−	14	5	Is	Low-grade dysplasia	EMR
2	58	M	Rb	55	LST-G	Low-grade dysplasia	En bloc	−	−	49	15	IIa	Low-grade dysplasia	ESD
3	52	F	C	50	LST-G	Low-grade dysplasia	En bloc	−	−	7	2	Is	Low-grade dysplasia	Hot biopsy
4	70	M	Rb	60	LST-G	Low-grade dysplasia	Piecemeal	+	−	10	10	Is	Low-grade dysplasia	EMR
5	70	M	Rb	20	Polypoid	High-grade dysplasia	En bloc	−	−	20	10	IIa	Low-grade dysplasia	EMR
6	64	M	S	25	LST-NG	High-grade dysplasia	Piecemeal	+	−	15	2	Is	Low-grade dysplasia	EMR
7	67	F	C	20	Polypoid	Low-grade dysplasia	En bloc	−	−	53	4	IIa	Low-grade dysplasia	EMR
8	56	F	A	25	LST-G	High-grade dysplasia	En bloc	−	−	7	10	Is	Low-grade dysplasia	EMR
9	74	M	S	40	LST-G	T1 carcinoma	En bloc	−	−	17	10	SMT	T1 carcinoma	Surgery
10	52	M	A	45	LST-G	High-grade dysplasia	Piecemeal	+	+	6	8	Is	Low-grade dysplasia	EMR
11	66	M	A	50	LST-G	High-grade dysplasia	Piecemeal	+	−	6	3	Is	−	APC
12	63	M	D	50	LST-G	High-grade dysplasia	En bloc	+	−	28	5	Is	−	APC
13	67	M	Rb	100	LST-G	High-grade dysplasia	En bloc	−	−	6	10	Is	Low-grade dysplasia	EMR
14	65	M	Ra	50	Polypoid	High-grade dysplasia	En bloc	+	−	17	5	Is	Low-grade dysplasia	EMR

HM, Horizontal margin; *VM*, vertical margin; *LST-G*, laterally spreading tumor of the granular type; *Rb*, rectum below the peritoneal reflection; *C*, cecum; *A*, ascending colon; *D*, descending colon; *S*, sigmoid colon; *Ra*, rectum above the peritoneal reflection; *LST-NG*, laterally spreading tumor of the nongranular type; *SMT*, submucosal tumor; *ESD*, endoscopic submucosal dissection; *APC*, argon plasma coagulation.

did not undergo surveillance colonoscopies after ESD. Finally, this study included patients whose treatment did not involve the use of the most advanced tools and devices for colorectal ESD.

In summary, ESDs for colorectal tumors that presented the greatest technical difficulties were performed at the high-volume centers, and there were no significant differences between the high- and low-volume centers with respect to the adverse events. The safety of colorectal ESD in the Hiroshima area was maintained, likely because the cases were allocated and the procedures were undertaken in accordance with the skill level of each facility and endoscopist.

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